Revised QA/QC Plan

133551

Extent of Contamination Study
Waukegan Tar Pit Study

Prepared for North Shore Gas Company
Elgin, Joliet and Eastern Railway Company
North Shore Sanitary District

November 1991

Engineering Company

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November 26, 1991

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Re: Waukegan Tar Pit Site

Dear Ms. Nolan, Mr. Mulrony, and Mr. Steadman:

Enclosed is a bound copy of the QA/QC Plan for the Supplemental Extent of Contamination Study Work Plan submitted pursuant to the September 4, 1991 unilateral Administrative Order, Docket No. V-W-'91-C-115, in the matter of Waukegan Tar Pit Site. This copy includes a section on groundwater monitoring that was not included with the previous QA/QC Plan submittal.

Please contact me with any questions or comments.

Sincerely,

Lawrence D. Dalen

JSL:crs
Enclosure
c: Russ Selman
Pat Doyle
Alice Saylor
Andrew Armstrong
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QUALITY ASSURANCE/QUALITY CONTROL PLAN

SUPPLEMENTAL EXTENT OF CONTAMINATION STUDY WORK PLAN

WAUKEGAN TAR PIT SITE

Prepared by: Barr Engineering Co. Date: 11/25/91

Approved: Lawrence D. Dalen Date: 11/26/91

Lawrence D. Dalen
Barr Engineering Project Manager

Approved: Mary Mackey Date: 11/26/91

Mary Mackey
Barr Engineering Quality Assurance Officer

QUALITY ASSURANCE/QUALITY ASSURANCE PLAN

SUPPLEMENTAL EXTENT OF CONTAMINATION STUDY WORK PLAN

WAUKEGAN TAR PIT SITE

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SECTION 3.0

PROJECT DESCRIPTION

3.1 INTRODUCTION

This Quality Assurance/Quality Control Plan presents the organization, objectives, functional activities and specific quality assurance (QA) and quality control (QC) activities associated with sampling and analysis activities as part of the work plan to implement the extent of contamination study at the Waukegan Tar Pit site.

This section describes the location, the existing conditions at the tar pit, history, the topography, and the findings of previous investigations at the tar pit. Based on that understanding of the site, target compounds are identified, project objectives are defined, and data quality objectives are developed.

3.2 SITE DESCRIPTION

The Waukegan Tar Pit Site (WTPS) is located in the east-central part of Waukegan, Illinois about 1/2 mile northeast of the downtown business district and 1/2 mile west of Lake Michigan. Figure 1 shows the WTPS location. Figure 2 shows the immediate vicinity of the WTPS, which is bounded on the north by Dahringer Road and beyond that by vacant property. It is bounded on the west by Pershing Road, and a rail yard of the Chicago Northwestern Railroad. A bluff rises beyond the rail yard and above the bluff line, about 2,000 feet from the WTPS is Sheridan Road and residential development. The WTPS is bounded on the east by the EJ&E railway line and the facilities of the NSSD. The WTPS is bounded on the south by vacant property owned by the City of Waukegan and EJ&E. The WTPS is bounded on all sides by a chainlink fence.

3.3 TAR PIT DESCRIPTION

The tar pit hereafter referred to is located in the northeast corner of the WTPS. The tar pit is covered by 4 to 6 inches of water and occupies an area estimated to be 15,800 square feet, or 0.36 acres, is the subject of the AOC.

The topography of the ground surrounding the tar pit is nearly level. According to the U.S. EPA, the soils immediately south of the tar pit are softer than elsewhere in the vicinity of the tar pit. Surface waters on the site are limited to water collecting on the tar pit.

3.4 TAR PIT HISTORY

The tar pit hereafter referred to is located in the northeast corner of the WTPS. The tar pit which is covered by 4 to 6 inches of water and occupies an area estimated to be 15,800 square feet, or 0.36 acres, is the subject of the AOC. The topography of the ground surrounding the tar pit is nearly level. Surface waters are limited to water collecting on the tar pit.

Sampling has yielded the following results:

- Water at the tar pit - benzene at 69 ppb, toluene at 59 ppb, and xylene at 18 ppb.

- Tar pit sediment - ethyl benzene at 230 ppm, xylene at 2,000 ppm, o-dichlorobenzene at 6,700 ppm, nitrobenzene at 620 ppm, benzene at 530 ppm, and toluene at 810 ppm.

- Tar 50 feet north of the pit - ethyl benzene at 710 ppm, xylene at 660 ppm, cyclohexane at 80 ppm, o-dichlorobenzene at 210 ppm, benzene at 180 ppm, and toluene at 380 ppm.

3.5 TARGET COMPOUNDS

Compounds of concern at the Tar Pit are listed in Table 1. All tar samples will be analyzed for the compounds in Table 1. Soil and groundwater samples will be analyzed for the compounds in Table 2. The compounds were selected based on:

- previously detected concentrations
- suspect contaminants from manufactured gas/coke plant operations

The quantitation limits for the target compounds are also provided in Table 1 and 2.

3.6 PROJECT OBJECTIVES

The objectives of this study as defined by the AOC are:

1. To conduct an extent of contamination study of the tar pit including sampling and analysis to define the vertical and lateral extent of contamination around in the tar pit, including soil and groundwater media.

2. To submit a report which shall summarize the study and identify the removal methods for the tar pit which must be protective of human health and the environment.

3.6.1 Data Quality Objectives

Data quality objectives (DQO) define and specify the quality of data required for the intended use of the data. The degree of certainty of a data set with respect to precision, accuracy, representativeness, completeness, and comparability is an indication of the data quality.

There are five defined levels of analytical data outlined below:

1. Level I -- Field Screening. The objective of this level of analysis is to generate data to be used in refining sampling plans; determining gross extent of contamination at the site and to select "worse case," representative," and "clean" samples for laboratory analyses. This type of data also provides real time monitoring for health and safety.

2. Level II -- Field Analysis. The objective of this level of analysis is to provide real-time data for on-going field activities or when initial data will provide the basis for the selection of additional laboratory analyses. Analyses include the use of an on-site close support laboratory.

3. Level III -- Laboratory Analysis. This level of support is designed to provide laboratory analyses using standard EPA-approved procedures other than the current CLP Routine Analytical Services (RAS). This level provides data for site characterization, environmental monitoring, confirmation of field data, and to support engineering studies.

4. Level IV -- Contract Laboratory Program (CLP) Routine Analytical Services (RAS). This level provides for the highest level of data quality with full CLP analytical, quality control, and validation procedures in accordance with EPA protocols. The data is used for risk assessment, confirmation of lower level data, and to obtain highly documented data.

5. Level V -- Nonstandard Methods. The objective of this level is to provide data not obtained through standard avenues of analytical support. This usually involves modification of existing methods or

method development. The level of quality control is usually similar to Level IV data.

The data quality objectives for the data collected during SI activities are specified below:

Sample Type	Field Parameters	Laboratory Parameters	Level of Data Quality
Tar Pit Composite	--	Volatiles	III
	--	Polynuclear Aromatic Hydrocarbons (PAHs)	III
Soil Samples	Field Screening	--	I
	--	Volatiles	III
	--	PAHs	III
Groundwater Samples	pH, Conductivity, Temperature	--	I
		Volatiles	III
		PAHs	III

3.7 SAMPLE NETWORK AND RATIONALE

3.7.1 Tar Pit Composite

The depth and thickness of the tar in the tar pit will be investigated by penetration techniques. A metal probe will be pushed into the tar as far as possible. Since the tar is much less resistant to penetration than the underlying soil, the depth of probe refusal should correspond to the depth of tar. The depth of probe refusal and the depth of overlying water, if any, will be recorded in the field. A tar sample will be collected at each of the three locations in Figure 3. The three samples will be homogeneously composited to make up one sample for analysis.

3.7.3 Soil Samples

The approximate locations of the proposed soil borings are shown in Figure 4. The rationale for the selection of the soil boring locations is listed in Table 3.

The results of the headspace screening of the soil samples collected during the installation of the soil borings will be used to determine which samples to send to the laboratory for analysis. Four to five soil samples thought to be "clean" based on the field screening will be sent to the laboratory for analysis. Two to three soil samples that appear to contain tar-like material but in the area near the edges of contamination will also be sent to the laboratory for analysis, if such material is found in the borings. The soil samples will be analyzed for the volatile and semivolatile organic compounds shown in Table 2.

3.7.3 Groundwater Samples

Four monitoring wells are proposed because the direction of groundwater flow in this area is not defined. The monitoring wells are located to provide measuring points for determining groundwater flow directions and with the intent to provide groundwater sampling locations that will be upgradient, downgradient, and lateral to groundwater flow, past the tar pit, no matter which direction is found to be flowing or if flow directions change. The proposed monitoring wells are approximately equally spaced around the tar pit.

The groundwater elevation will be measured in each monitoring well prior to pumping and sampling. Groundwater samples will be collected from each of the monitoring wells once each quarter for three quarters. The sample collection and handling procedures are described in the QA/QC plan. The groundwater samples will be analyzed for the volatile and semivolatile organic compounds shown in Table 2.

SECTION 4.0

PROJECT ORGANIZATION

4.1 BARR ENGINEERING CO. PERSONNEL AND RESPONSIBILITIES

Barr Engineering Co. (Barr) is responsible for study design, field investigation activities, coordination of subcontractors (drillers, excavators, analytical laboratories), tar sampling, data review, and reporting.

The project team consists of a principal, project manager, hydrogeologist, project geologists, project safety officer, quality assurance manager, and support staff.

The Barr principal, Dean Malotky, is responsible for overall management of the project and assurance that the goals of timeliness, quality, and cost-effectiveness are met.

The Barr project manager, Lawrence Dalen, is responsible for: preparing work plans and scoping documents; coordination, scheduling, and oversight of project activities with project team members; communicating with the client, subcontractors, and the MPCA project manager, and the analytical laboratories; and reporting of the data and findings generated by the study.

The project hydrogeologist, Ray Wuolo, is responsible for coordinating the tar investigation, collection of soil samples, well installation, and preparation of sample logs.

The project safety officer, Mary Dymond, is responsible for developing the RFI site safety plan, coordinating the safety training and medical monitoring of investigation personnel, and maintaining safety records.

The Barr quality assurance officer, Mary Mackey, is responsible for assisting the project manager in specifying project QA/QC procedures, specifying

field sampling and sample analysis methods to be used in the study, auditing the sampling and analytical activities to ensure that the proper techniques and appropriate quality control procedures are followed, reviewing analytical results and quality control data, recommending corrective actions when necessary, and preparing a quality control report.

Review of analytical results and quality control data by the quality assurance officer will include:

- Determination of potential outliers.
- Determination of potential false positive values based on review of field blanks and laboratory blanks.
- Assessment of the precision and accuracy of the analytical results of environmental samples.
- Assessment of the precision of the analytical results of interlaboratory split samples and masked duplicate samples.
- Examination of raw data on analyses that are considered suspect or anomalies.

4.2 LABORATORY RESPONSIBILITY AND ORGANIZATION

CH_2M Hill Environmental Laboratory (CH_2M Hill) will be responsible for the analysis of tar samples. Herb Kelly, Organic Division Manager, will be responsible for overall project management, data validation and quality assurance activities at the laboratory. Additional information on the organizational structure of the laboratory is provided in Figure 5.

SECTION 5.0
QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA IN TERMS OF PRECISION, ACCURACY, COMPLETENESS, REPRESENTATIVENESS AND COMPARABILITY

The overall QA objectives are to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting that will provide the level of data required for determining the concentration of the analytical parameters in soil and groundwater. Specific procedures to be used for sampling, chain-of-custody, calibration of field instruments, laboratory analysis, reporting, internal quality control, audits, preventative maintenance, and corrective actions are described in other sections of this QAPP. This section will address the objectives of precision, accuracy, completeness, representativeness and comparability.

- Precision measures the reproducibility of measurements under a given set of conditions. It is a measure of the variability of a group of measurements compared to an average value.

- Accuracy measures the bias in a measurement system. Possible sources of error are the sampling process, field contamination, preservation, handling, sample matrix, sample preparation, and analysis techniques.

- Completeness is defined as the percentage of measurements made that are judged to be valid measurements.

- Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or environmental conditions.

- Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another.

To assess these five parameters, both sampling and analysis options are employed.

5.1 SAMPLING QUALITY ASSURANCE

5.1.1 Field Sampling

Field duplicate (replicate) samples will be collected in the field and submitted to the laboratory to assess the sampling precision. Field duplicate (replicate) samples will be used to assess the combined effects of sample collection, handling, and analysis on data precision. Sampling accuracy is assessed through evaluation of results of both field and trip blanks. Field blanks will be analyzed to check for procedural factors or ambient conditions at the site that may cause contamination. Trip blanks will be prepared and analyzed for each cooler containing groundwater volatile organic compound samples to check for cross-contamination that may occur during sample storage or shipment. Results of blank samples will be evaluated and reported to assist in the determination of potential false positive sample results. All blank samples will be prepared using organic-free deionized water provided by the laboratory and using the identical sample volume, containers and preservation as regular investigative samples.

The frequency of collection of trip blank samples, field blank samples and field duplicate (replicate) samples is outlined in Section 6.6.

The goal of completeness is to ensure that a sufficient amount of valid data are generated. The number of samples obtained should provide sufficient amount of valid data.

The objective of representativeness is to assess whether the information obtained during the investigation accurately represents actual site conditions. The sampling network was designed to provide data representative of site conditions. All field sampling activities will be performed following standard

sampling techniques. The field sampling activities are outlined in the field sampling plan. Factors which will be considered during the evaluation of representativeness include:

- Environmental conditions during sampling
- Sampling and analytical methodologies
- Sampling network - location and number of samples
- Analytical parameters

The use of standard sampling procedures and recognized field techniques for sampling should make the resulting data comparable to other measurements on similar samples under similar sampling conditions.

5.1.2 Field Measurements

Specific procedures used in field measurements are provided in Section 6.0. Calibration procedures are described in Section 8.0.

To achieve completeness and a sufficient amount valid data from field measurements, invalid measurements will be repeated using another instrument or after recalibration of instruments. The completeness will be acceptable if valid results are obtained for greater than 90 percent of the samples.

Representativeness and comparability of field measurements is achieved by the use of standard techniques to analyze samples.

5.2 LABORATORY QUALITY ASSURANCE

The QA goals for the analytical services are established in the laboratory QA Manual. Precision and accuracy requirements for analyses are specified in

the laboratory/analytical procedures. Precision and accuracy data that meet the precision and accuracy requirements of the laboratory QA program will be sufficient to meet the objectives of this project. Data that do not meet precision and accuracy requirements will be assessed on a case by case basis to determine if they are usable to support project objectives.

Data completeness will be quantified during data assessment. The goal for completeness on this project is 95 percent. All data that meet QA/QC acceptance criteria will be used in the decision making process, even if the data set as a whole or if any analytical fraction does not meet the completeness goal.

The use of standard sampling techniques and the design of the sampling network should provide data representative of site conditions. The use of standard procedures to analyze representative samples should provide comparable data.

SECTION 6.0
SAMPLING PROCEDURES

6.1 INTRODUCTION

The general objective of sampling is collection of a sample representative of conditions at the monitoring point. The project-specific sampling objectives will be established by the project manager before field activities begin. Project specific objectives and site conditions will dictate the location and type of sample collected (soil or groundwater), sampling procedures, and sampling equipment. The project objectives are described in Section 3 of this document.

Prior to visiting the facility, all team members will review the sampling plan, the site safety plan, and the QAPP. If necessary, a project team meeting will also be conducted with the purpose of clarifying the tasks and objectives of the project, and reviewing available site information.

Before sampling commences, a visual evaluation of the site will be conducted. The visual evaluation will include observation of sampling points, routes of access, key landmarks, and assessment of potential hazards. During sample collection, the work plan and QAPP will be followed in detail, and the sampling procedures and pertinent observations will be documented.

If potentially hazardous samples are collected, samples and sampling gear will be decontaminated as specified in the safety plan prior to leaving the facility.

6.2 SAMPLING EQUIPMENT

Before use, all soil sampling, groundwater sampling, well developing and purging equipment will be carefully cleaned. All groundwater sampling equipment except bailers will be cleaned with soap and water and rinsed with tap water and

deionized water prior to use. A dedicated bailer will be used at each well to prevent cross contamination when collecting samples. Bailers will be cleaned in the laboratory with soap and water and rinsed sequentially with tap water and deionized water. Bailers will then be baked at 200°C for at least one hour. The bailers will be transported to the field wrapped in aluminum foil. Each specially prepared bailer will be used to collect samples from only one well before being returned to the laboratory for cleaning.

All drilling equipment, such as hollow stem auger flights, hollow stem auger plugs, rotary bits, rotary drill rod, and downhole tools, will be steam cleaned before use and between boreholes. Soil sampling equipment, such as stainless steel spoons or scoops, stainless steel hand augers, and split-spoon sample barrels, will be cleaned before use and between samples. All cleaning conducted in the field or field repairs will be documented in field records.

6.3 SAMPLING AND INVESTIGATION PROCEDURES

6.3.1 Tar Depth and Extent Investigation

The depth and thickness of the tar in the pit will be investigated by penetration techniques. The following procedures will be used:

1. A three-person crew will be used to collect data on tar depth. Two of the site crew will perform the penetration tests and a third site crew member will operate survey equipment adjacent to the tar pit. Two of the crew members will drag equipment to the predesignated sampling locations over ice on the tar pit. Life jackets will be worn at all times, whether the ice is supportable or not. In addition, a safety rope will be tethered to the plywood panel and extend to the third crew member at the edge of the tar pit.

2. A metal probe approximately 6-feet long and 1/2-inch in diameter will be pushed by hand into the tar as far as possible. Since the tar is

much less resistant to penetration than the underlying soil, the depth of probe refusal should correspond to the depth of tar. If there is ice on the pond, an access hole will be chopped or augured into the ice. The depth of probe refusal and the depth of overlying water, if any, will be recorded in the field. Surveying instruments located adjacent to the pit will be used to survey elevation, location, and sample points. Survey data will be keyed into a known benchmark.

Three vane shear tests may be performed at selected locations. To verify that the material underneath the tar is substantially more resistant to penetration than the tar material, The vane shear apparatus consists of a narrow wooden paddle attached to a shaft. The vane is inserted into the tar and a torque wrench is used to record the amount of force necessary to twist the paddle in the tar. The paddle is pushed at successively deeper depths and the shear test is repeated until further penetration is not possible. The relative resistance to shear is noted as a function of depth and the results is compared to the rod penetration tests performed at adjacent locations.

6.3.2 Collection of Tar Samples

A tar sample will be collected at each of approximately three locations. Samples will be collected with a small trowel and each sample will be placed in a new 1-gallon metal paint cans and sealed. Sampling procedures will be as follows:

1. An access hole through the tar pit ice will be chopped or augured through the ice by the two-man sampling crew.

2. One crew member will use a trowel to reach below the ice and retrieve a tar sampling to a depth of approximately 6 inches. Tar samples

will be placed in new 1-gallon paint cans. Approximately 4 quarts of tar will be obtained from each sampling location. The 1-gallon paint can will be sealed after each sample is collected.

3. A third crew member will operate survey equipment adjacent to the tar pit to collect data on the location of each sampling point.

4. The composite sample will be prepared by mixing equal portions of sample from each of the sample locations in a 1-gallon paint can.

6.4 GROUNDWATER SAMPLING

6.4.1 Well Development

Monitoring wells will be developed by air and/or water jetting in conjunction with air-lifting. Final development will be accomplished by using a bladder pump, submersible pump, or bailer. Pump inlets and bailers will be constructed of stainless steel and/or teflon. Pumps and bailers will be equipped with check valves to prevent water from re-entering the well.

A stabilization test will be conducted on each new monitoring well after the well appears to be fully developed (free of visible sediment) to determine if the well is adequately developed. When a stabilization test is performed, specific conductance, pH, and temperature will be measured at intervals of one well volume.

Stabilization is achieved when all parameters show three consecutive equivalent values within the following range:

Specific Conductance (temperature corrected)	0-500 scale $\pm$5 μmhos/cm 500-5,000 scale $\pm$50 μmhos/cm
pH	$\pm$0.1 pH units

Temperature	±0.5°C

A minimum of five well volumes will be removed from the well during a stabilization test.

6.4.2 Well Purging

Prior to purging and sampling a monitoring well, the depth to water from the top of the riser pipe will be measured to the nearest 0.01 of a foot.

Monitoring wells will be purged prior to sampling using a bladder pump, submersible pump, or bailer. Pump inlets and bailers will be constructed of stainless steel and/or teflon. Pumps and bailers will be equipped with check valves to prevent water from re-entering the well.

A stabilization test will be conducted on each monitoring well during purging. The stabilization test procedure is described in Section 6.4.2 of this QAPP.

A minimum of five and a maximum of 20 well volumes will be removed from a well during purging. Stabilization is achieved when all parameters show three consecutive equivalent values within the range of variability specified in Section 6.4.2.

Monitoring wells open to low permeability formations that do not recharge 90 percent of their well volume within one hour after being pumped (or bailed) empty will be sampled without stabilization.

6.4.3 Sampling Order

A sampling order will be established prior to sampling and followed during collection of samples. Whenever possible, the monitoring wells will be sampled in order of "clean to dirty".

Samples will be collected and containerized in order of the parameters' sensitivity to volatilization. Samples will be collected in the following parameter order:

- volatile organic compounds
- semivolatile organic compounds
- extractable petroleum hydrocarbons
- metals
- general chemistry parameters

NOTE: Not all parameter groups will be required for all projects.

6.4.4 Sample Collection

Samples will be collected from the monitoring wells using a bailer with stainless steel retrieval wire. The wire will be stored on a spool (downrigger) to prevent contact with the ground. The bailer will be carefully lowered into the well and samples will be collected from a consistent depth below the water surface.

Samples for all parameters will be collected by carefully removing the cap from the appropriate sample container. The interior of the sampling bottle and cap will also be protected from contact by anything but the sample. If a sample container becomes contaminated, the container will be discarded and a replacement container will be used to collect the sample.

Sample containers for parameters other than volatile organic compounds will be filled in a manner which minimizes aeration, and will be filled to within approximately 1 inch of the top.

Sample containers for volatile organic compound analyses will be collected with minimal aeration and no headspace will be left in the sample vial following

capping. If headspace is found in the vial, the vial will be discarded and a replacement will be collected.

Samples for metals will be filtered using dedicated filtering equipment immediately after sample collection. Surface water samples will not be filtered.

6.5 SOIL/SEDIMENT SAMPLING PROCEDURES

Locations for soil sampling will be selected in order to collect "worst case" or representative fraction of the soils with the minimum number of samples and expense. A surface inspection of the subject area will be made to locate pertinent features (e.g., rock outcrops, drainage patterns, fill areas, erosional areas, depositional areas, etc.) and to evaluate the relationship between these features and potential sampling constraints. Utilities in the vicinity of proposed sampling will be located and digging permits will be obtained from Base authorities.

Deeper Subsurface Soil Sampling (0->10 feet) -- Deeper subsoil sampling will typically be performed by advancing borings with hollow-stem augers or tricone mud rotary and collecting samples with split-spoon samplers. These techniques are described below.

6.5.1 Hollow-Stem Augers

Hollow-stem augers have a continuous flight-cutting blade around a hollow metal cylinder. A stem with a plug is ordinarily kept inside the auger barrel to prevent soil from entering. When core samples are desired, the stem is withdrawn and a tube sampler or split-barrel (see below) driven beyond the bottom of the auger. This drilling method may be used for continuous soil sampling. Hollow-stem auger and split barrel sampling will likely be used primarily for subsurface sampling from the surface to a depth of 50 feet.

6.5.2 Tricone Mud Rotary

For boreholes to be advanced to depths of more than 50 feet, the drilling method will change from hollow-stem auger to tricone mud rotary at a depth of approximately 50 feet. The tricone bit will be attached to a drilling rod. Drilling fluid, a bentonite and water mixture, is circulated down the drilling rod and up the borehole. A portion of the fluid or "mud," coats the sides of the borehole soils allowing the borehole to remain open so that the drilling tools may be advanced. Split-spoon samples are collected as in the hollow stem auger method.

6.5.3 Split-Barrel Samplers

A split-barrel consists of a hollow steel cylinder split in half and screwed into an "unsplit" outer tube and tip. This assembly is connected to drill rods and forced into the soil by dropping a 140-pound sliding hammer along the drill rod[1]. The number of hammer blows required to advance the sampler in 6-inch increments will be recorded. The total blow count number for the second and third increments is related to a standard engineering parameter indicating soil density. After the tube is pulled from the soil, the cylinder is removed from the drill rod and opened, exposing the soil core.

A hollow brass cylinder separated into three removable sections will be placed inside the split-spoon as a liner. The brass liner will collect and retain the soil core as the split-spoon is hammered into the soil. A clean brass liner is used for each sample collected. Brass liners are utilized to lessen the possibility for sample cross-contamination from the split-spoon.

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[1]"Standard Method for Penetration Test and Split-Barrel Sampling of Soils", ASTM D4586-84.

6.6 QUALITY CONTROL SAMPLES

6.6.1 Trip and Field Blanks

Trip blanks generally pertain to volatile organic water samples only. Trip blanks are prepared prior to the sampling event in the actual sample containers and are kept with the investigative samples throughout the sampling event. They are then packaged for shipment with the other samples and sent for analysis. There should be one trip blank included in each sample shipping container. At no time after their preparation are the samples containers opened before they reach the laboratory.

Field blanks are defined as samples which are obtained by running analyte-free deionized water through sample collection equipment (bailer, pump, auger, etc.) after decontamination, and placing it in the appropriate sample containers for analysis. These samples will be used to determine if decontamination procedures have been sufficient. Using the above definition, soil field blanks could be called rinsate samples. These should be included in a sampling program as appropriate.

The following guidelines for including blanks in sampling programs will be followed:

- Ground and surface water -- Field blanks should be submitted at the rate of one field blank/matrix/per day or one for every 20 investigation samples, whichever results in fewer samples. Trip blanks should be included at a frequency of one per day of sampling or as appropriate.

- Soil sediments and solids -- Rinsate samples should be submitted at the rate of one for every 20 investigative samples for each matrix being sampled or as appropriate.

6.6.2 Field Duplicate Samples

Duplicate samples are independent samples collected in such a manner that they are equally representative of the parameter(s) of interest at a given point in space and time. Duplicate samples, when collected, processed, and analyzed by the same organization, provide intralaboratory precision information for the entire measurement system including sample acquisition, homogeneity, handling, shipping, storage, preparation and analysis. Duplicate samples are submitted to the laboratory as blind or mask samples.

The following guidelines for the inclusion of field duplicate samples will be followed:

- Ground and surface water -- One out of every 10 investigative samples should be duplicated. These samples should be spread out over the sampling event.

- Soil, sediments and solids -- One out of every 20 investigative samples should be field duplicated. These samples should be spread out over the sampling event.

6.7 SAMPLE STORAGE

All sample containers will be protected from light and cooled to 4°C. Replicate sample vials collected for volatile organic analyses will be sealed as sample sets in ziplock plastic bags. All sample containers will be segregated to the extent possible in sample storage coolers according to expected concentrations of contaminants.

6.8 SAMPLE CONTAINERS, PRESERVATION AND HOLDING TIMES

Sample containers, preservation techniques and holding times are outlined in Table 4. All sampling containers will be supplied by the analytical laboratory.

6.9 FIELD ANALYSES

6.9.1 Groundwater Samples

Specific conductance, temperature, and pH will be measured in the field immediately after collecting water samples. The following instruments or their equivalent will be used for analyses in the field:

- Orion Research Model 407A pH meter
- YSI Model 33 specific conductance meter

The pH meter and specific conductance meter will be calibrated as described in Section 8.2.

6.9.2 Organic Vapor Field Screening Method for Soils

Field screening will be performed as described in the Standard Operating Procedure, Attachment 1.

6.10 SAMPLE IDENTIFICATION AND NUMBERING

Water samples will be identified with a number unique to the location of the monitoring well or station. Soil boring samples will be identified using a unique location number and a suffix identifying the depth at which the sample was collected.

QC samples will be identified with the following prefixes followed by a sequential number:

- FB - Field Blank (FB-1, FB-2 ....)
- TB - Trip Blank (TB-1, TB-2 ....)
- M - Field (Mask) Duplicate Sample (M-1, M-2 ....)

6.11 SAMPLE TRANSPORTATION

Samples will be delivered or shipped to the laboratory via a next-day delivery service within 36 hours of sample collection. Shipping receipts will be retained for all samples.

SECTION 7.0
CHAIN-OF-CUSTODY

7.1 FIELD CHAIN-OF-CUSTODY

7.1.1 Sample Identification

A label will be attached to each sample container before the sample is collected. The label will contain the sampling station identification, date collected, project identification number, and sampler's initials. An example of the sample label is provided in Figure 6.

7.1.2 Field Logs

A field log will be maintained throughout the monitoring program. Field measurements and other pertinent information about field activities will be recorded.

7.1.3 Chain-of-Custody

The field sampler will be responsible for custody of samples until they are properly dispatched to the laboratory or turned over to an assigned custodian. The field sampler will ensure that possession or sight of sample containers is maintained at all times or that the containers are stored in a securely locked area. A chain-of-custody form is shown in Figure 7.

The chain-of-custody procedures will apply to all samples collected. All entries will be completed in indelible ink. The original chain-of-custody record and one copy will be sealed in a waterproof container and shipped inside the sealed transportation case. A second copy of the record will be retained by the sampling team, and the third copy will be retained by the Barr Engineering Co. quality assurance manager.

The addresses of the consignee and consignor will be printed on the outside of the transfer container or attached firmly thereon by cards and labels. As necessary, warning and descriptive labels will be attached to the transfer container. A chain-of-custody record will be included with each transfer container to identify the samples in the transfer container and to summarize the analyses to be carried out on each sample.

7.2 LABORATORY CHAIN-OF-CUSTODY

7.2.1 Sample Receipt

All samples submitted are delivered to the laboratory's central sample receiving area and are received by the sample coordinator. The sample coordinator compares the samples received against the chain-of-custody record.

If all samples recorded on the chain-of-custody were received by the laboratory and there are no problems observed with the sample shipment, the Sample Coordinator signs the chain-of-custody record in the "received for laboratory by:" box on the document.

If problems or discrepancies are found, they are documented on the chain-of-custody form before the document is signed. The client is notified immediately by telephone, and necessary laboratory actions are discussed and agreed upon.

A letter is sent to the client acknowledging receipt of samples and noting what problems, if any, were found. A copy of this letter is filed with the original chain-of-custody form with the case file.

7.2.2 Sample Log-In and Set-Up Procedures

Following the careful inspection of shipping container(s), records, and samples as required in the sample receipt procedure, the samples are recorded

in a master sample receipt logbook with the following information: client name, project code, date received, and laboratory batch number. This same information is then transferred to a project specific file if appropriate.

The laboratory sample number is a sequential number that is unique to that sample. Samples are processed through the laboratory by the laboratory sample number.

The Sample Coordinator completes a worksheet detailing specific information and requirements of the sample. All data is then entered into the LIMS system by the Sample Custodian. The data entered is verified by the LIMS Data Base Specialist.

Work-in-Progress Sheets (WIPS) are printed by LIMS for each laboratory area each night. This enables laboratory supervisors to schedule analyses and to monitor work flow, track holding times, and ensure that samples are analyzed in a timely fashion.

Samples with fast turnaround times, samples with short holding times, or samples approaching the end of holding time on arrival in the laboratory are treated according to the same procedure except that the sample numbers and parameters are entered into the logbook for short holding times located in the sample custody area. The Sample Coordinator notifies the appropriate analyst or supervisor of the arrival of such samples. This enables analysts to begin analyses before WIPS are produced in the following day.

The storage area is kept secure at all times. The Sample Coordinator has the key and controls access to the storage area. (A duplicate key is maintained by appropriate personnel.)

Samples and extracts are stored after completion of analysis for a period of up to 30 days from final report date, at which time they may be returned to the generator in accordance with lab waste disposal protocol.

Standards are not stored with samples. Volatile and semivolatile standards are stored separately.

7.3 CUSTODY OF EVIDENCE FILE

Until completion of the project, all correspondence, laboratory reports, and data will be maintained in Barr Engineering project files. All original laboratory reports and field data are maintained in their original format and stored separately from working copies of these reports. The Barr project manager will direct maintenance of the project file. Following completion of the project, the evidence file will be stored in the Barr Engineering Co. project file storage area or transferred to a secure document storage facility.

SECTION 8.0

CALIBRATION PROCEDURES AND FREQUENCY

8.1 LABORATORY CALIBRATION PROCEDURES

Laboratory calibration procedures and criteria specified are outlined in the analytical procedure. Every instrument used to analyze samples must pass the calibration criteria established in the appropriate SOP.

8.2 FIELD EQUIPMENT CALIBRATION PROCEDURES

The accuracy of field measurements of pH, temperature, organic vapor concentration, and specific conductance will be addressed through calibration measurements at the beginning of the day and calibration measurement verifications periodically throughout the day and the end of the day.

The accuracy of pH measurements will be assessed by performing measurements on two standard buffer solutions which bracket the pH range of the samples. Each measurement will be within $\pm$0.05 standard unit of buffer selections. Precision will be assessed through duplicate measurements and must be less than or equal to 0.1 standard unit. The electrode will be withdrawn, rinsed with deionized water, and reimmersed between each duplicate. The instrument used will be capable of providing measurements of 0.01 standard unit.

Temperature will be measured using a thermometer on the conductivity meter with a range of -2° to 50°C and with divisions of 1°C. The thermometer on the conductivity meter will be checked before each sampling event for accuracy against an ASTM, NBS, or equivalent, calibrated thermometer. Accuracy of measurement will be $\pm$1°C.

Specific conductance will be measured using a conductivity meter. The meter will be read to the nearest 10 micromho/cm within a range of 0 to 20,000 micromho/cm. The meter will be calibrated daily by insertion of the

conductivity probe into a 0.01 N standard KCl solution before sample analysis and at the end of the day. Accuracy of measurements will be ±5 percent of the standard. Precision will be assessed by analysis of duplicate samples which must have a relative percent difference of ≤15 percent.

SECTION 9.0

ANALYTICAL PROCEDURES

Soil and Groundwater samples collected will be analyzed according to the laboratory methods and quantification limits specified in Table 2.

Tar samples collected will be analyzed following the EPA procedures outlined in Test Methods for Evaluating Solid Waste, SW 846, Method 8020 for benzene, toluene, ethylbenzene, and xylenes, and Method 8100 for polynuclear aromatic hydrocarbons (PAHs).

SECTION 10.0

INTERNAL QUALITY CONTROL CHECKS

10.1 LABORATORY ANALYSES

To monitor laboratory performance during the course of the sample analysis and to ensure data quality, an internal quality control program has been implemented. Replicates, blanks, and spiked samples are analyzed. Analytical procedures present guidelines for the number and frequency of quality control samples. The quality control samples are analyzed in the same manner as field samples and are interspersed with the field samples according to the accepted protocol or SOP. Analytical results of the quality control samples are used to document the validity of data and to control data quality within predetermined acceptance limits. Quality control charts for surrogate recovery and other QC samples are maintained to determine if the analytical system is in control and to detect trends and excursions.

10.2 FIELD ACTIVITIES

Field quality control checks will be performed on-site and will not involve samples that are collected and retained. The primary QA/QC objective is to obtain reproducible measurements to a degree of accuracy consistent with limits imposed by analytical methodologies used and with the intended use of the data. Quality control procedures will be limited to checking the reproducibility of measurements by taking multiple readings and by calibration of instruments (where appropriate).

SECTION 11.0

DATA REDUCTION, VALIDATION, AND REPORTING

11.1 DATA REDUCTION

11.1.1 Laboratory Analysis

Analysts are responsible for the reduction of raw data when such steps are required to produce the correct data format for reporting. Data reduction may be done manually or through one of a number of computer programs used in the laboratory.

11.1.2 Field Measurements

Raw data from field measurements and sample collection will be recorded on the field data sheets. All specific conductivity data will be corrected to 25°C. The data will be transferred from field data sheets to a computer database and output in a spreadsheet format.

11.2 DATA VALIDATION

11.2.1 Laboratory Analysis

When data has been acquired for a sample, the initial review is done by the analyst. This review covers sample identification, check of analyses requested against the LIMS record, review of procedures and notebook data, checking of calculations done, QC data, and checking for transcription errors. Following this review, the sample data with supporting information as required may be reviewed by a peer, but is always reviewed by the analyst's supervisor.

The supervisory review includes checking for correct analyses performed, correct sample identification, proper choice of method, correct calculations,

investigation of all related quality control data, and correct transcription of all data.

The ultimate responsibility for the analytical results lies with the division manager who makes the final review. All out-of-control conditions noted are reviewed by the Laboratory Quality Assurance Coordinator (LQAC) and the division manager. Decisions concerning these out-of-control conditions are made jointly by the division manager the LQAC.

After data has been entered into the reporting system, a draft report is reviewed by the supervisor or division manager. This review includes a check of holding times met, correct analysis and report dates, and correct reporting units, as well as a review of results, quality control data, and transcription. At any point in the review process, if an error is found, the analyst has the responsibility for investigating the problem and initiating the correction. During the review process, points which should be brought to the client's attention, such as missed holding times or matrix effects noted in samples, are noted for inclusion in the case narrative or cover letter.

The LQAC routinely checks approximately 90 percent of completed data packages before submittal to the client.

Data validation is part of the review process whereby data are inspected and either accepted or rejected based on a set of criteria. Before analytical results are reported to the client, this review and approval process must be completed.

The analyst has the initial responsibility for proper instrument conditions and calibration, for the data meeting all acceptance criteria, and for all calculations being accurate. After proper instrument conditions and calibration are verified, data generated is validated on the basis of accuracy, precision, and how the data compare with the established limit of detection. Attention is

paid to possible outliers. Statistical tests are used to ensure that if data are rejected, it is done with a high level of confidence.

Laboratory analysis reports will generally be submitted to Barr Engineering Co. within 4 weeks after receipt of samples.

Data will be evaluated by the Barr Engineering QA officer to determine if it meets project requirements. Data validation procedures will be consistent with the EPA documents for Laboratory Data Validation - Functional Guidelines for Evaluating Organic Analyses and Inorganic Analyses. The specific requirements which will be checked during data validation are listed below:

1. Holding Times
2. Method Blanks
3. Surrogate Recovery
4. Matrix Spike/Matrix Spike Duplicate
5. Field Duplicates
6. Field Blanks
7. Overall Data Assessment

Upon completing the validation procedure for all data, a quality control review report will be compiled and submitted to the client and regulatory agencies overseeing the project.

11.2.2 Field Measurements

Data validation of field measurements will be the responsibility of the QA Officer. The application of statistical evaluation procedures are not appropriate for field measurements. Field notes will be checked to verify that specific QC procedures including instrument calibration were performed. Data will be proofed from field notebooks against computer spreadsheets. Calculations performed by the sampler will be rechecked.

11.3 DATA REPORTING

11.3.1 Laboratory Analysis

Laboratory analyses reports will generally be submitted to Barr Engineering Co. within 4 weeks of the receipt of samples. There are three basic levels of data reporting. The levels differ in the number and frequency of quality control samples run and in whether or not samples such as spikes and duplicates are client-specific or run-specific.

Level 1 offers a basic sample data package with no client-specific QC samples. Level 2 includes client-specific quality control samples and some additional information. Level 3 corresponds to a full CLP package.

Data generated will be reported by the laboratory using a Level 1 reporting format. The laboratory data package will include at a minimum:

1. Date of Extraction/Analysis
2. Method Blank Data
3. Surrogate Recovery Data

Data will be entered into a computer database and output in spreadsheet format to be used in reports. An example spreadsheet is presented in Table 4.

11.3.2 Field Measurements

Field data will be summarized and output on computer spreadsheets along with the laboratory data for reports.

SECTION 12.0

PERFORMANCE AND SYSTEM AUDITS

12.1 EXTERNAL AUDITS

12.1.1 Laboratory Audits

The laboratory is presently certified in many states and under several certification programs.

The laboratory submits to external on-site system audits conducted by the states in which it is certified or seeking certification and by other certifying agencies.

12.1.2 Field Audits

All field activities conducted by Barr may be subject to on-site audit by EPA. Audits will be arranged with the Barr QA Officer.

12.2 INTERNAL AUDITS

12.2.1 Laboratory Audits

Internal audits of the laboratory are conducted in two phases.

The first phase is conducted by the District Quality Assurance Manager at least once a year. This is usually a 2-day systems audit which covers all sections of the laboratory. An audit report is issued within 2 weeks of completion. The LQAC has the responsibility for coordinating all responses to the audit finding and for following up on the required corrective action. A follow-up audit is made when deemed necessary by the District QA manager.

The second phase consists of quarterly audits performed by the LQAC. These are day-long audits and are concerned on specific areas that are deemed problem areas by the LQAC. An audit report is issued at the completion of the audit. Responses and follow-up corrective action to the audit findings are required and are monitored by the LQAC.

All audit reports are issued to management and circulated to all staff. Copies are filed with the District Quality Assurance Manager and the LQAC.

12.2.2 Field Audits

Field performance audits are conducted periodically by the Barr QA Officer to evaluate the preservation techniques and sample identification, field quality control, equipment, calibration, chain-of-custody procedures, field documentation, training, and overall sampling operation. Audits evaluate compliance with the procedures outlined in the QAPP and/or other working documents. The Barr QA Officer will verify that all tasks described in the Work Plan have been conducted completely and in accordance with the QAPP.

12.2.3 Other Internal Audits

Barr, through its QA Officer, will be responsible for conducting internal performance and system audits of its subcontracting laboratories. Audits will be completed at a frequency of once per year.

Internal audits of the laboratory will assess the compliance with the laboratory portions of the QAPP; the RCRA Laboratory Audit Inspection Form from the "RCRA Laboratory Audit Inspection Guidance Document, September 1988" and the current revisions of the Organic and Inorganic Statements of Work for the CLP will guide the internal audit.

The on-site inspection will cover:

A. Qualifications of the laboratory personnel and the organizational structure of the laboratory

B. Procedures for maintaining laboratory supplies and equipment

C. Procedures for equipment calibration

D. Procedures for sample handling

E. Quality Control procedures

G. Procedures for data handling, reporting, record keeping

The on-site visit will also serve as a mechanism for discussing weaknesses identified through review of data deliverables. Lastly, the on-site visit will allow Barr to determine if the laboratory has implemented the recommended and/or required corrective actions, with respect to quality assurance, made during any previous on-site visits.

An internal laboratory audit report will be prepared by the Barr QA Officer. The audit report and any checklists or worksheets will be kept on file with the Barr QA Officer.

SECTION 13.0

PREVENTIVE MAINTENANCE

13.1 LABORATORY INSTRUMENTS

Preventive maintenance, such as lubrication, source cleaning, and detector cleaning, is performed according to the procedures delineated in the manufacturer's instrument manuals.

The frequency of preventive maintenance varies with different instruments. Routine maintenance performed includes cleaning and/or replacement of various instrument components. In general, the frequency recommended by the manufacturer is followed. In addition to the regular schedule, maintenance is performed as needed. Precision and accuracy data are examined for trends and excursions beyond control limits to determine evidence of instrument malfunction. Maintenance is performed when an instrument begins to degrade as evidenced by the degradation of peak resolution, shift in calibration curves, decreased ion sensitivity, or failure to meet one or another of the quality control criteria.

Instrument maintenance logbooks are maintained in the laboratory at all times. The logbook contains a complete history of past maintenance, both routine and nonroutine. The nature of work performed, the date, and the signature of the person who performed the work are recorded in the logbook. Preventive maintenance is scheduled according to each manufacturer's recommendation. Instrument downtime is minimized by keeping adequate supplies of all expendable items on hand. Expendable items are those with an expected lifetime of less than one year.

Routine instrument preventive maintenance is handled by the instrument operator. Repair maintenance is performed by a full-time electronics technician or by the manufacturer's service personnel.

13.2 FIELD INSTRUMENTS

Field instruments are calibrated as described in Section 8.2. Initial calibration will be conducted before sampling occurs. If results indicate meter malfunctioning, corrective actions will be taken (i.e., clean probe, etc.).

SECTION 14.0
SPECIFIC ROUTINE PROCEDURES TO ASSESS DATA PRECISION, ACCURACY AND COMPLETENESS

Precision, accuracy, and completeness are defined in Section 5.0. Equations for calculating precision, accuracy, and completeness are detailed below.

Both field duplicates (replicates) and laboratory duplicates are analyzed to determine data precision. The results are reported as the relative percent difference (RPD) and are calculated by:

$$RPD = \frac{D1 - D2}{(D1 + D2)/2} \times 100$$

where:

D1 = concentration of first duplicate
D2 = concentration of second duplicate

Spiked sample analyses are used to determine the accuracy of analyses. A known quantity of the constituent of interest is added to a sample and analyzed. The amount of spiked compound recovered by analysis is compared to the amount added. Percent recovery (%R) is calculated by:

$$\%R = \frac{SSR-SR}{SA} \times 100$$

SSR = quantity measured in spike sample
SR = quantity measured in unspiked sample
SA = quantity of spike added

The completeness of data from a sampling program is interpreted as the percentage of valid data obtained compared to the amount that was expected to be obtained.

$$\text{Completeness} = \frac{\text{Data values useable}}{\text{Total data values obtained}} \times 100$$

14.1 QUALITY CONTROL (QC) REVIEW

Data will be assessed by Barr Engineering Co. for the following QC elements:

- Sample Holding Times
- Accuracy of Spiked Samples
- Precision of Duplicate Samples
- Instrument Calibration
- Blank Results
- Surrogate Recovery
- Comparison with Historical Data
- Potential False Positive Results

A Quality Control Review Form will be completed for each laboratory report to summarize this data evaluation.

All quality control reviews will be discussed with the project manager to determine the useability of the data.

SECTION 15.0
CORRECTIVE ACTION

Corrective action for this project is the responsibility of Barr Engineering Co. Corrective action will be implemented if it is determined that the data generated will not fulfill the project objectives.

When the QC data exceed the acceptance criteria, corrective actions will be implemented. Possible corrective actions might include:

1. Reanalysis of samples

2. Recollection and analysis of samples

15.1 LABORATORY CORRECTIVE ACTION PROCEDURES

The laboratory has a Corrective Action System that ensures the proper documentation and dispositions of conditions requiring corrective action. The system also ensures that the proper corrective action is implemented to prevent recurrence of the condition.

The Corrective Action System applies to all situations that affect data quality. These situations include, but are not limited to, quality control criteria being exceeded, statistically out-of-control events, deviations from normally expected results, suspect data, deviations from the standard operating procedure, and special sample handling requirements. Corrective actions may also be initiated as a result of other QA activities, such as performance audits, systems audits, laboratory/interfield comparison studies, and QA project-related requirements of certifying agencies such as FDER.

The procedure requires documenting the condition requiring corrective action on a Corrective Action Report and implementing corrective action based

on the results of the investigation performed to determine the cause of the condition. Appendix B includes examples of corrective action forms.

When a condition requiring corrective action arises, the Corrective Action Report is initiated. The initiator describes the condition requiring corrective action. An investigation, if necessary, is conducted to determine the cause of the condition. A corrective action is recommended based on the results of the investigation. The Corrective Action Report is reviewed by the division manager and the LQAC who either approve the recommended corrective action or indicate a different corrective action. The originator has the responsibility of following up to be sure that the corrective action is implemented. Implementation of the corrective action is documented by the Corrective Action Report being signed and dated by the person who implemented the corrective action.

Corrective action conditions are documented, whenever appropriate, on the case narrative. The client is notified whenever warranted.

SECTION 16.0

QUALITY ASSURANCE REPORT TO MANAGEMENT

The quality assurance performance will be addressed in the final report to client. Any non-compliance with the QAPP or project concerns will be immediately reported to the project manager.

Tables

TABLE 1
TARGET COMPOUNDS AND QUANTITATION LIMITS
(µg/Kg)

Parameter	Quantitation Limit
Naphthalene	50
2-Methylnaphthalene	50
1-Methylnaphthalene	50
Acenaphthylene	50
Fluorene	50
Phenanthrene	50
Anthracene	50
Fluoranthene	50
Pyrene	50
Benzo(a)anthracene	50
Chrysene	50
Benzo(b)fluoranthene	50
Benzo(k)fluoranthene	50
Benzo(a)pyrene	50
Indeno(1,2,3-cd)pyrene	50
Dibenzo(a,h)anthracene	50
Benzo(g,h,i)perylene	50
Benzene	50
Ethylbenzene	50
Toluene	50
Xylene	50

The above quantitation limits do not account for any dilutions which may be required during sample analysis.

TABLE 2

SOIL AND GROUNDWATER TARGET COMPOUNDS AND QUANTITATION LIMITS

	Quantitation Limits	
	Water (µg/L)	Soil (µg/L)
Volatile Organic Compounds (EPA SW846-8240)		
Benzene	5	5
Toluene	5	5
Ethyl Benzene	5	5
Xylenes, total	5	5
Methylene Chloride	5	5
Acetone	10	10
2-Butanone	10	10
Styrene	5	5
Semivolatile Organic Compounds (EPA SW846-8270)		
2,3-Benzofuran	10	330
2,3-Dihydro-1H-Indene	10	330
1H-Indene	10	330
Naphthalene	10	330
Benzo(b)thiophene	10	330
Isoquinoline	10	330
2-Methylnaphthalene	10	330
Indole	10	330
1-Methylnaphthalene	10	330
Biphenyl	10	330
Acenaphthalene	10	330
Acenaphthene	10	330
Dibenzofuran	10	330
Fluorene	10	330
Dibenzothiophene	10	330
Phenanthrene	10	330
Anthracene	10	330
Acridine	10	330

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TABLE 2 (continued)

SOIL AND GROUNDWATER TARGET COMPOUNDS AND QUANTITATION LIMITS

	Quantitation Limits	
	Water (µg/L)	Soil (µg/L)
Phenanthridine	10	330
Carbazole	10	330
Fluoranthene	10	330
Pyrene	10	330
Triphenylene	10	330
Benzo(g,h,i)perylene	10	330
7,12-Dimethylbenzene(a)anthracene	10	330
Benzo(e)pyrene	10	330
Perylene	10	330
3-Methylcholanthrene	10	330
Quinoline	10	330
Benzo(a)anthracene[1]	10	330
Chrysene[1]	10	330
Benzo(b)fluoranthene[1]	10	330
Benzo(a)pyrene[1]	10	330
Indeno(1,2,3-cd)pyrene[1]	10	330
Dibenz(a,h)anthracene[1]	10	330
Benzo(k)fluoranthene[1]	10	330

TABLE 3 (Cont.)

RATIONALE FOR SELECTION OF SOIL BORING LOCATIONS

Proposed Soil Boring	Rationale

TABLE 3

RATIONALE FOR SELECTION OF SOIL BORING LOCATIONS

Proposed Soil Boring	Rationale
B-36	Located southeast of B-34, east of B-35, and south of B-31. Soil boring B-36 is located to further delineate the southern extent of tar material in the soil, particularly in the area east of B-35. Boring B-31 contained some tar and soil containing tar at depths of 10 to 20 feet. Boring B-34 contained tar and soil containing tar at depths of 10 to 14 feet. Borings B-33 and B-35 did not contain tar material. Absence of tar in B-36 will complete the delineation of the southern boundary of tar material.
B-37	Located northwest of B-29. Soil boring B-37 is located to further delineate the extent of tar southwest of the tar pit. Boring B-29 contained stringers of tar material from depths of 6 to 18 feet. Boring B-26 contained tar-like material mixed with soil from depths of 6 to 11 feet. Boring B-33 did not contain tar. Absence of tar in B-37 will provide delineation of the extent of tar southwest of the tar pit.
B-38	Located west of B-25, northwest of B-26, and southwest of B-24. Boring B-38 is located to further delineate the extent of tar west of the tar pit. Boring B-26 contained tar-like material mixed with soil from 0 to 11 feet and stringers of tar to 22 feet. Boring B-26 contained tar-like material mixed with soil from depths of 6 to 11 feet. Boring B-24 did not contain tar material. Absence of tar in B-38 will provide delineation of tar west of the tar pit.
B-39	Located west of B-23, northwest of B-24, and southwest of B-7. Boring B-39 is located to further delineate the extent of tar northwest of the tar pit. Borings B-7 and B-24 did not contain tar. Boring B-23 contained tar-like zones of material mixed with soil from the ground surface to a depth of approximately 18 feet. Absence of tar in B-39 will provide delineation of tar northwest of the tar pit.

TABLE 3 (Cont.)

RATIONALE FOR SELECTION OF SOIL BORING LOCATIONS

Proposed Soil Boring	Rationale
B-40	Located along the north fence line, west of B-20. Boring B-40 is located to further delineate the extent of tar north-northwest of the tar pit. Boring B-20 contained stringers of tar from 0 to 4 feet. Absence of tar in B-40 will provide delineation of tar north-northwest of the tar pit.
B-41	Located along the north fence line near the junction with the east fence line. Boring B-40 is located to further delineate the extent of tar northeast of the tar pit. Boring B-40 will be located east of Boring B-17. Boring B-17 contained a thin stringer of tar-like material at approximately 10 feet. Boring B-41 is located to verify that the tar-like material is absent or very thin northeast of the tar pit.
B-42	Located along the east fence line, east of the tar pit, and north of B-15. Boring B-42 is located to further delineate the extent of tar east of the tar pit. Boring B-15 did not contain visible tar, but was advanced only to a depth of 1 foot.
B-43	Located along the east fence line, east of the tar pit, and in the approximate location of B-15. Boring B-43 is located to further delineate the extent of tar east of the tar it. Boring B-15 did not contain visible tar, but was advanced only to a depth of 1 foot.
B-44	Located along the east fence line, east of the tar pit, south of B-15, and north of B-16. Boring B-44 is located to further delineate the extent of tar east and southeast of the tar pit. Boring B-15 did not contain visible tar, but was advance only to a depth of 1 foot. Boring B-16 did contain some tar at a depth of 1.2 feet.

TABLE 4

SAMPLE CONTAINERS AND PRESERVATION TECHNIQUES

Parameter	Container	Preservative	Holding Time
Soil Samples			
Volatiles	Two 2-oz. glass teflon-lined cups	Cool, 4°C	14 days
PAHs	One 16-oz. glass teflon-lined cup	Cool, 4°C	7 days extraction 40 days analysis
Water Samples			
Volatiles	Three 40-ml glass vials, teflon septum	Cool, 4°C HCL to pH <2	14 days
PAHs	2-liter amber glass, teflon cup	Cool, 4°C	7 days extraction 40 days analysis

Figures

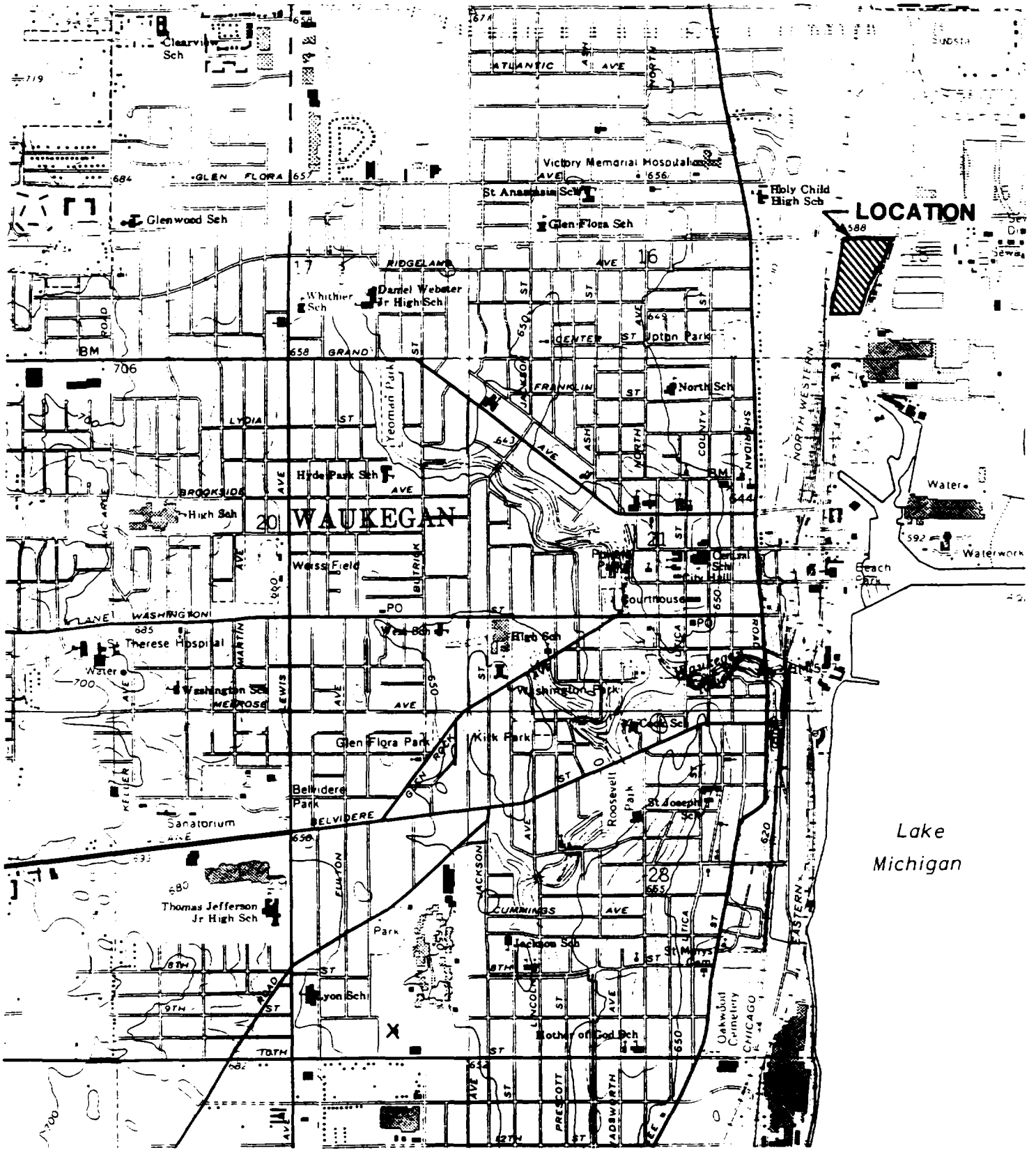
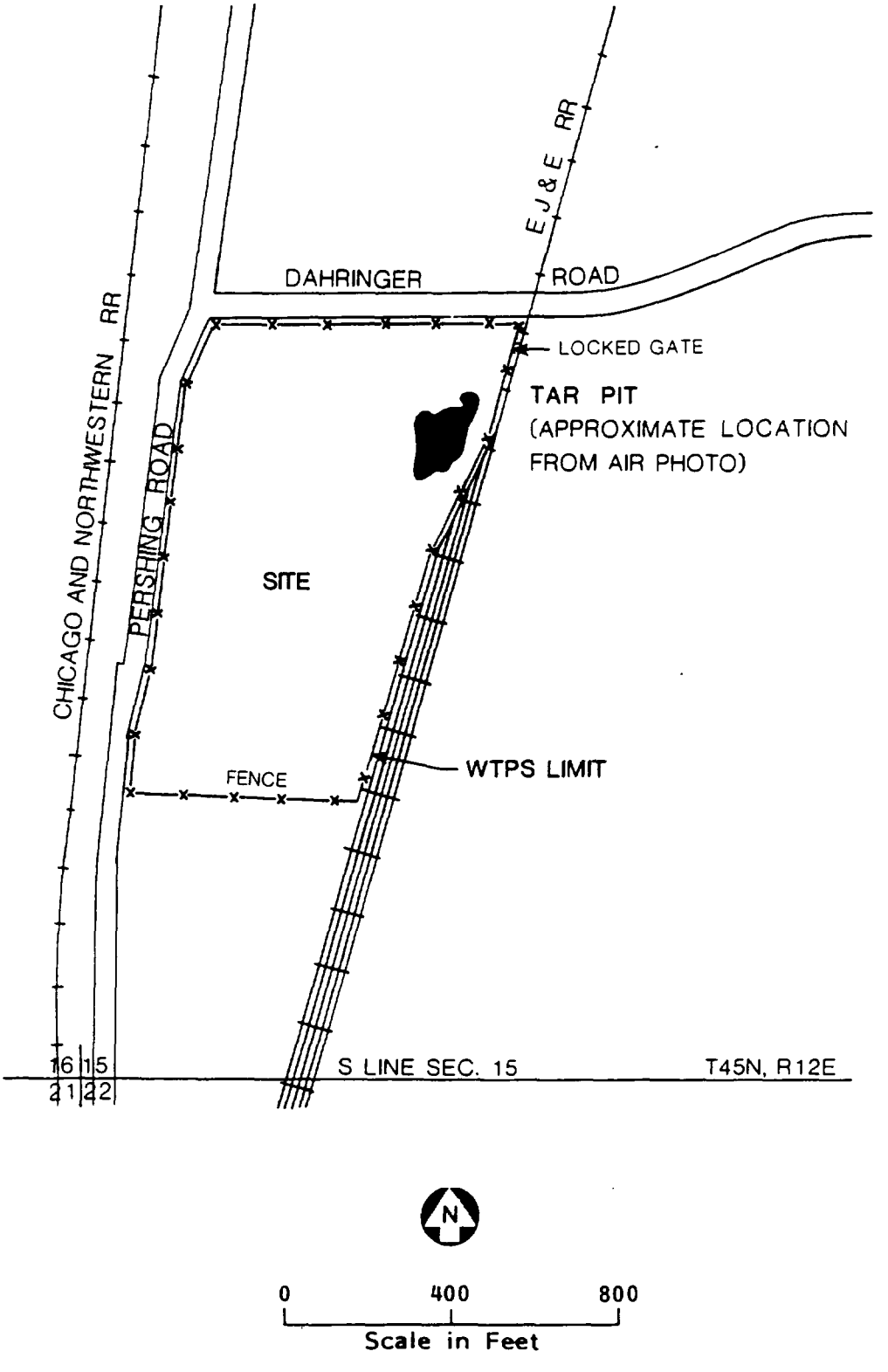


Figure 1

Waukegan Tar Pit Site
LOCATION MAP



—x—x— Chain Link Fence
(Approximate Location)

Figure 2

Waukegan Tar Pit Site
MAP OF IMMEDIATE VICINITY AND TAR PIT

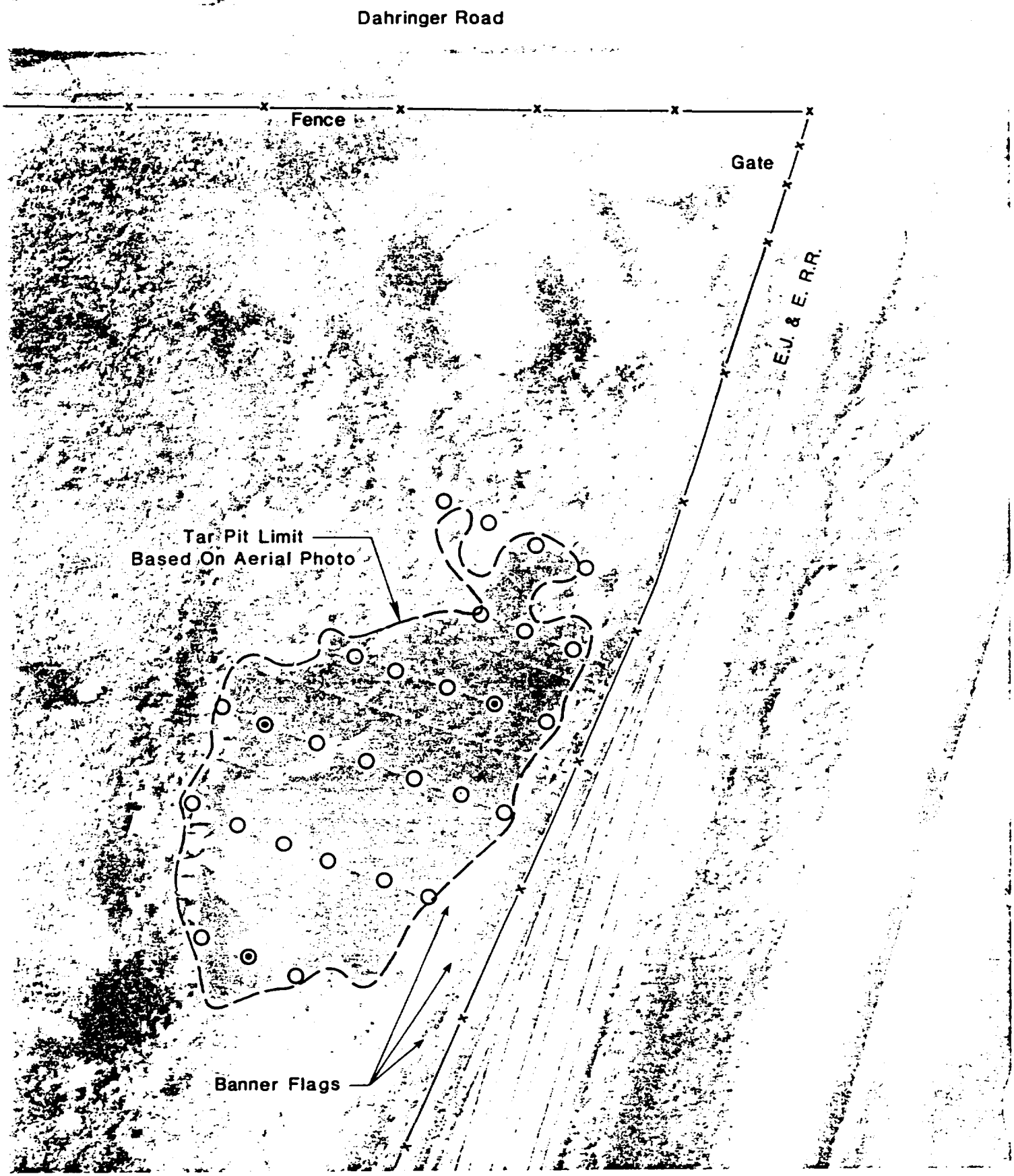


FIGURE 3

○ Tar Depth Location

⊙ Tar Depth & Sample Location

N

0 50

Scale in Feet

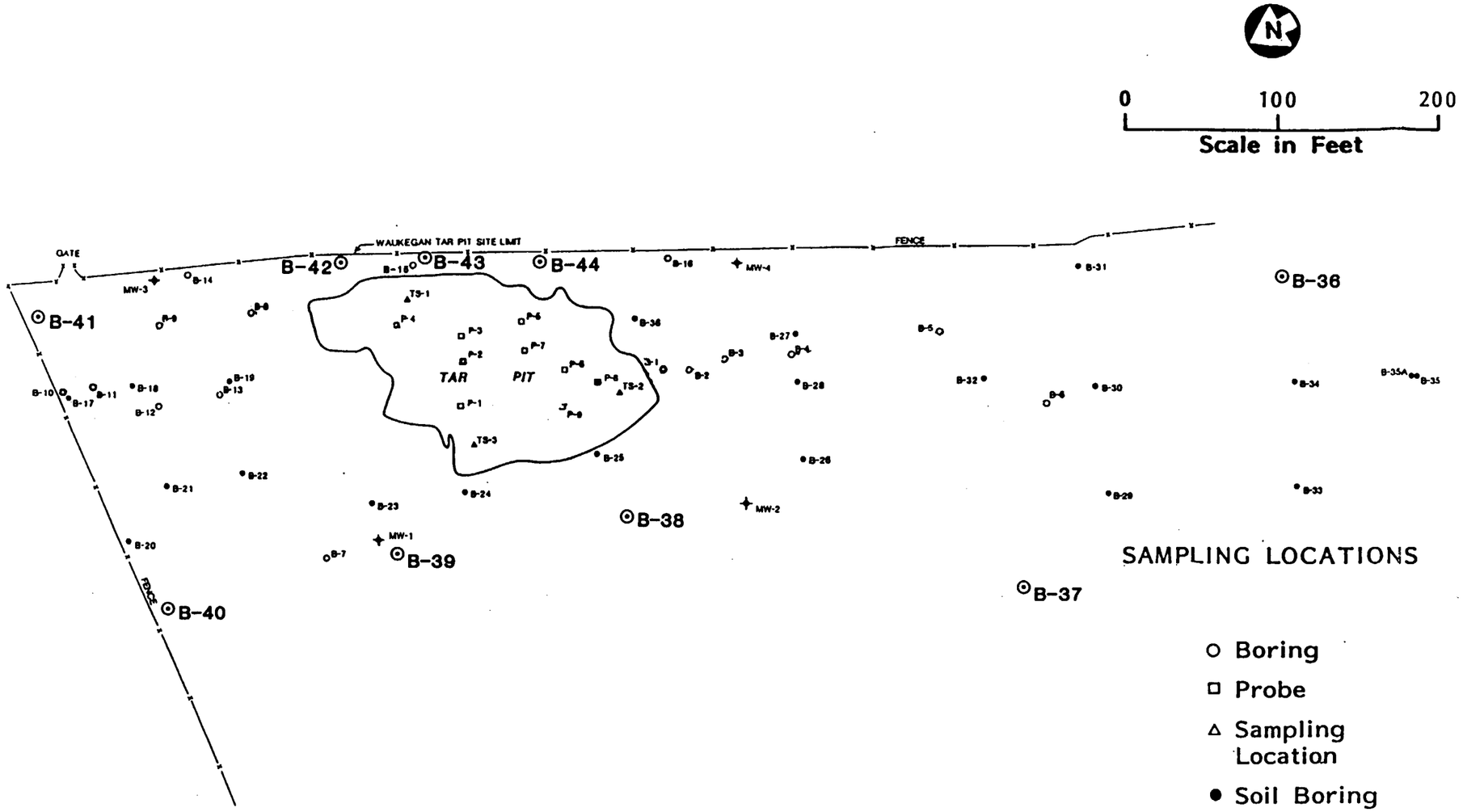


Figure 4

EXISTING AND PROPOSED
BORING AND WELL LOCATIONS
Waukegan Tar Pit Site
(WTPS)

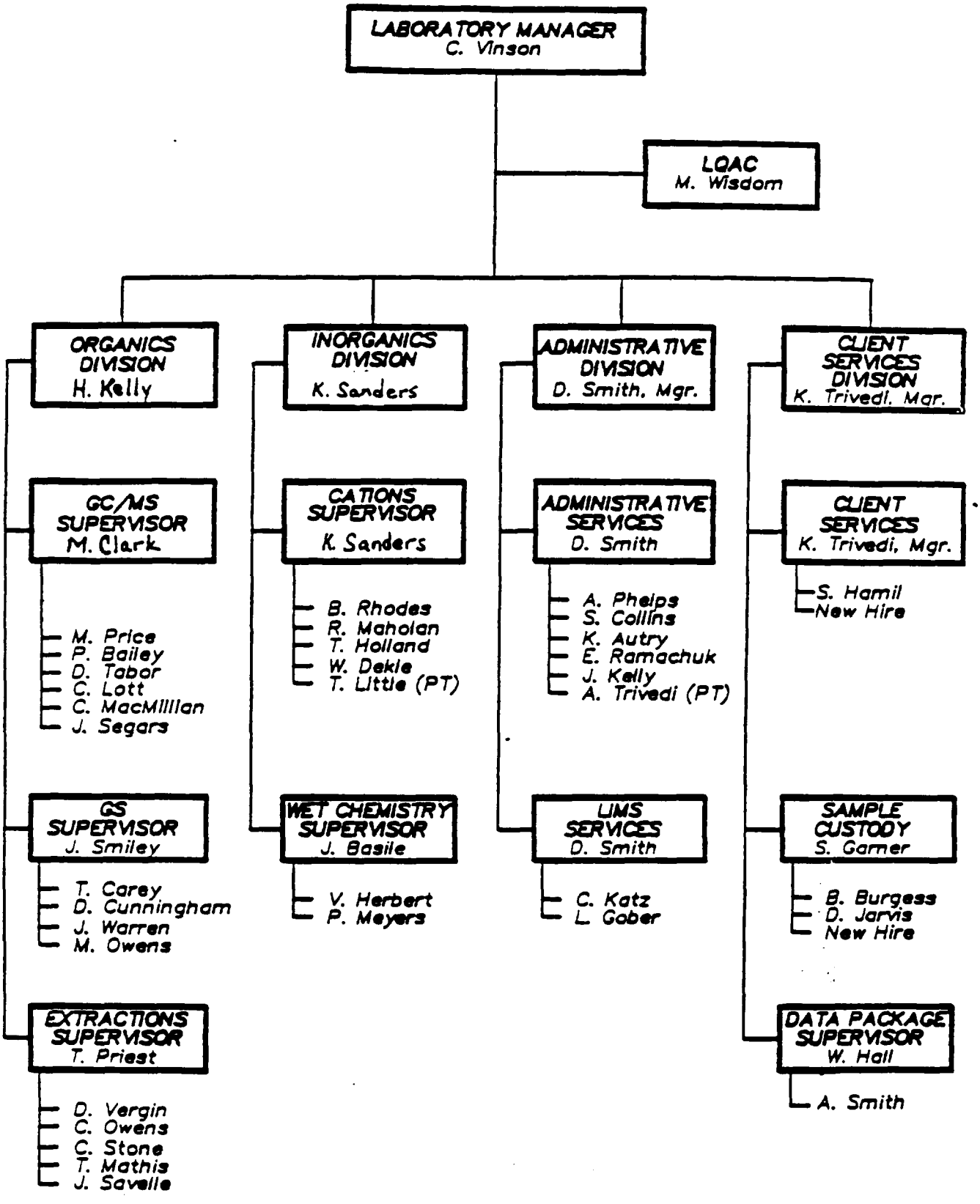


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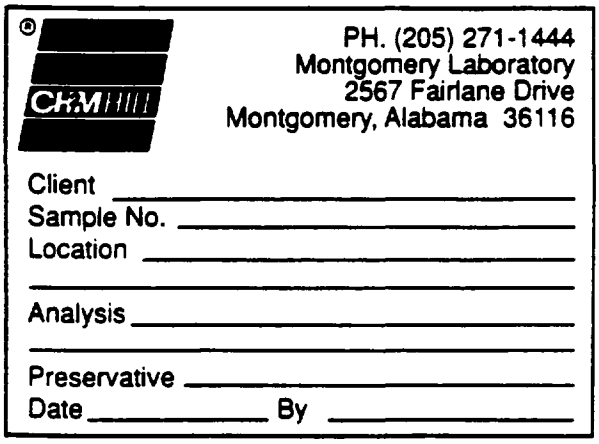
FIGURE 5
MONTGOMERY LABORATORY
ORGANIZATIONAL CHART
APRIL 1990

CH2MHILL

50.DWG

FIGURE 6


CH2M HILL
PH. (205) 271-1444
Montgomery Laboratory
2567 Fairlane Drive
Montgomery, Alabama 36116
Client
Sample No.
Location
Analysis
Preservative
Date
By

CHAIN OF CUSTODY

BARR ENGINEERING CO.
7803 GLENROY ROAD
MINNEAPOLIS, MN. 55435

PROJECT NUMBER

NO: № 020442

SAMPLE IDENTIFICATION	COLLECTION DATE	COLLECTION TIME	GRAB	COMP.	BLANK	CONTAINER TYPE AND NUMBER: VOLATILE ORGANIC	PAH/PHENOLS	FILTERED METALS	UNFILTERED METALS	MERCURY	COD	GENERAL	CYANIDE	NUTRIENTS	REMARKS/ ANALYSIS REQUIRED

PROJECT MANAGER:

PROJECT CONTACT:

LABORATORY:

REMARKS/ ANALYSIS REQUIRED:

SAMPLED BY:	RELINQUISHED BY:	DATE	TIME	RECEIVED BY LAB:	DATE / TIME
RECEIVED BY:	RELINQUISHED BY:	DATE	TIME	RECEIVED BY LAB:	DATE / TIME
RECEIVED BY:	RELINQUISHED BY:	DATE	TIME	RECEIVED BY LAB:	DATE / TIME
REMARKS	SAMPLES SHIPPED VIA ☐ AIR FREIGHT ☐ FED. EXP. ☐ SAMPLER ☐ OTHER			AIR BILL NUMBER:	

DISTRIBUTION: WHITE-ORIGINAL ACCOMPANIES SHIPMENT TO LAB, RETURNS TO BARR WITH RESULTS; YELLOW-LAB COPY; PINK-LAB COORDINATOR; GOLD-FILED COPY

FIGURE 7

Attachment

ATTACHMENT 1

STANDARD OPERATING PROCEDURE FOR FIELD SCREENING TECHNIQUES FOR SOILS CONTAINING COAL TAR

The field screening techniques for soils containing coal tar are as follows: (1) Visual Examination; (2) Oil Sheen; (3) Odor; and (4) Headspace Organic Vapor Screening. The results of these four screening procedures will be used to determine the gross level of PAH contamination of the soil sample.

Visual Examination. A visual examination of the soil sample will include noting any discoloration of the soil or the presence of coal tar.

Oil Sheen Test. The oil sheen test is a method used to immediately determine the approximate magnitude of coal tar contamination in soil by observation of the sample in the field. The test is useful in soils which do not have a high binding capacity with polyaromatic hydrocarbons (PAHs) (i.e., the PAHs are free on the surface of the soil particles and can be released by a stream of water).

The equipment required to conduct the oil sheen test includes: a stainless steel spoon, a squirt bottle filled with tap water, a log book or recording sheet, and the appropriate personal protective equipment necessary for collection and handling of soil samples as described in the Health and Safety Plan. Decontamination of the spoon between test events will consist of scrubbing the surface of the spoon with a solution of trisodium phosphate in water using a brush and then rinsing the spoon with water.

The procedure for conducting the oil sheen test consists of obtaining approximately 50 grams (about 30 cc) of representative soil with the spoon and then directing a stream of water onto the soil in the spoon with the squirt bottle until the soil is saturated and water begins to collect around the soil. The amount of oil sheen present on the water is determined by observation and the results of the test are reported as a magnitude of oil sheen observed: none, trace, moderate, or heavy. The test results, sample location, and observations of the sample's appearance and odor are recorded in the log book.

The specific soil types at the area of investigation should be accounted for when performing the oil sheen test. The best results are obtained in silts, sands, and/or gravels with low organic content. The results obtained from clayey soils may appear deceptively low. Typical descriptions of each test result are given below.

Oil Sheen Test Result	Description
None	No sheen detected.
Trace	Possible or faint oil sheen observed (May not continue to generate sheen as additional water is added).
Moderate	Definite oil sheen, but "rainbow colors" not distinguishable.
Heavy	Definite oil sheen with "rainbow colors" observed.

Interferences on the test can be caused by any contaminant which will cause an oil sheen on water. The samples will be carefully observed for characteristic appearance or odors which may indicate a possible contaminant other than coal tar.

Odor. Odor will be described as low, moderate, strong, or very strong coal tar odor, or as diesel or petroleum odor. The sampler will note odor

only if noticed incidentally while handling the soil sample. The sampler will not place themselves at risk.

Headspace Organic Vapor Screening. The headspace organic vapor screening method will be used in the field to screen soils for organic vapors. The screening method is intended to be used in conjunction with other "real time" observations which include a description of the odor and appearance of the soil sample and an measure of the oiliness of the soil sample.

The equipment required to conduct headspace organic vapor screening includes: a clean pint or quart-size glass jar with lid, aluminum foil, stainless steel spoon, a log book or recording sheet, and the appropriate personal protective equipment necessary for collection and handling of soil samples as described in the Health and Safety Plan.

The following procedure will be used for conducting headspace organic vapor screening:

1. Soil samples collected from a split-barrel sampler will be collected immediately after opening the split-barrel. If the sample is collected from an excavation wall, soil pile, or backhoe bucket, it will be collected from a freshly exposed surface.

2. Half fill a clean glass jar with the sample to be analyzed using a stainless steel spoon. Quickly cover the open top of the jar lid on tightly to seal the jar.

3. Vigorously shake the jar for 15 seconds.

4. Allow headspace development for 10 minutes. Ambient temperature during headspace development should be recorded. When ambient temperatures are below 32°F, headspace development should be conducted inside a heated vehicle or building.

5. Vigorously shake the jar for an additional 15 seconds.

6. Remove the jar lid to expose the aluminum foil seal. Quickly puncture the foil seal with the sampling probe to a point about one-half of the headspace depth. Exercise care to avoid uptake of water droplets or soil particles.

7. Record the highest meter response as the headspace concentration. The maximum response will likely occur between two to five seconds.

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City: Minneapolis
State: MN
ZIP Required: 55437

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Department/Floor No.:
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Department/Floor No.: Suite 300
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City: Minneapolis
State: MN
ZIP Required: 55437

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